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EUS-Guided Transluminal Interventions


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The role of endoscopic ultrasound (EUS) has transitioned from a diagnostic to a therapeutic one over the past 40 years. With the advent of curvilinear array echoendoscopes in the 1990s with an accessory channel, multiple tools and devices have been developed and used for a variety of transluminal interventions. EUS provides a viable option and is becoming the procedure of choice for many interventions, including bile and pancreatic duct drainage, guiding angiotherapy, pancreatic fluid collection management, gallbladder drainage, and creating a gastrojejunostomy. Although reports demonstrate the technical success of these interventions, there is tremendous study heterogeneity and a relative lack of controlled randomized trials, which may limit our understanding of their role and utility. Furthermore, adverse events are relatively common and occasionally severe. Despite the limitations, available data strongly indicate the efficacy of EUS interventions when performed by well-trained endosonographers in carefully selected patients and managed in a multidisciplinary setting.

Keywords: EUS-Guided Gallbladder Drainage (EUS-GBD); EUS-Guided Gastroenterostomy (EUS-GE); EUS-Guided Pancreatic Fluid Collection Drainage (EUS-PFC Drainage).

It has been nearly 40 years since endoscopic ultrasound (EUS) was introduced, and for much of its history has served primarily a diagnostic role.[1] The introduction of curvilinear array instruments in the mid-1990s allowed for cytohistological tissue acquisition.[2,3] More recently, interventional capabilities of EUS have been realized, and the purpose of our article was to focus on several interventions, namely EUS-guided (1) bile and pancreatic duct access and drainage, (2) angiotherapy, (3) pancreatic fluid collection drainage, (4) gallbladder drainage, and (5) gastroenterostomy.

Patient Preparation

Common to each intervention is the need for careful patient preparation and planning. Although EUS is routinely performed in an ambulatory setting, some interventional procedures and patients are best treated within a hospital endoscopy unit that provides high-quality fluoroscopy, monitored anesthesia care or general anesthesia, and appropriately skilled staff. A thorough history, physical examination, and medical chart review is needed to determine the indication, risks, benefits, and alternatives to EUS. Pertinent laboratory analysis and cross-sectional imaging are obtained to evaluate the underlying disorder, delineate the anatomy, and to guide all planned interventions. Relative contraindications include significant coagulopathy (international normalized ratio >1.5), thrombocytopenia (platelets $<50{,}000$), hemodynamic instability precluding adequate sedation, multiple ductal strictures, and intervening structures that prohibit access. Following consideration of each of these factors, written informed consent is obtained. Antibiotics (eg, levofloxacin or ciprofloxacin) are routinely administered before the procedure and occasionally for several days thereafter. Carbon dioxide also should be used to minimize the risk of pneumoperitoneum.

EUS-Guided Biliary and Pancreatic Duct Access and Drainage

Endoscopic retrograde cholangiopancreatography (ERCP) has long been the technique of choice for accessing and draining the bile and pancreatic duct. Although percutaneous and surgical approaches provide an alternative,[4,5] EUS-guided techniques have recently emerged as a

Abbreviations used in this paper: **AE, adverse event; CE-LAMS, cautery-enhanced lumen apposing metal stents; EUS, endoscopic ultrasound; EUS-BBD, EUS-guided gallbladder drainage; EUS-GBD, EUS-guided gallbladder drainage; EUS-GE, EUS-guided gastroenterostomy; FCSEMS, fully covered self-expanding metal stents; FNA, fine-needle aspiration; GIB, gastrointestinal bleed; GVs, gastric varices; LAMS, lumen apposing metal stents; PFC, pancreatic fluid collection; PTGBD, percutaneous gallbladder drainage; PQ, percutaneous; S-GJ, surgical gastrojejunostomy; WON, walled off necrosis.**

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potentially safer and less invasive alternative. EUS may be particularly suited for patients with anatomical distortions (eg, duodenal diverticulum, luminal obstruction, or disrupted duct) or surgically altered anatomy (eg, pancreaticoduodenectomy), or in those who are poor operative candidates and when surgical interventions are declined. Similar to ERCP, EUS techniques are used to manage benign and malignant diseases.

The use of EUS-guided biliary drainage (EUS-BD) can be used after failed ERCP for management of unresectable malignancy, but caution against its use for resectable disease, as these interventions may risk tumor seeding. For benign disease, there are too few data to support the routine role of EUS-BD, except for wire placement to aide subsequent biliary cannulation via ERCP. There is even more uncertainty in terms of EUS-guided pancreatic drainage (EUS-PD), with the clearest indication for managing postoperative patients with anastomotic strictures in whom standard techniques have low rates of technical success. These uncertainties further emphasize the need to evaluate and manage these patients as part of a multidisciplinary team.

Equipment Needs and Technical Considerations

Although small-caliber diagnostic echoendoscopes suffice for rendezvous wire passage or placement of small-caliber ($\leq$7-Fr) stents, some advocate use of therapeutic linear echoendoscopes that permit passage of all accessories and stents. The caliber of the needle and guidewire must be considered to ensure compatibility. Selection of 19-gauge fine-needle aspiration (FNA) needles permits use of larger 0.035-inch wires that are stiffer and may permit traversal of tight or tortuous strictures and facilitate subsequent passage of dilating catheters and stents. Small-caliber and more flexible 22-gauge needles facilitate initial duct access, but their use is limited by need for small-caliber 0.018- or 0.021-inch guidewires that, because of their flexibility, are more challenging for maintaining access and longitudinal orientation during dilation and stenting. However, smaller gauge guidewires may be less prone to shearing due to the additional space within the needle and decreased resistance to torque and retraction against the sharp needle tip. Teflon-coated hydrophilic wires and/or angled wires may also facilitate traversal of narrowed and/or tortuous segments. Equipment selection is largely guided by procedural goals. For instance, 25-gauge needles may be preferred if the intent is merely to obtain a cholangiogram or pancreatogram to identify a critical stenosis that requires stenting, as in assessing pancreatojejunal anastomosis patency following pancreaticoduodenectomy. Endosonographers must be technically facile and willing to use varied equipment to achieve success.

Techniques and Terminologies

Wiersema et al[6] first performed EUS-guided cholangiography following failed ERCP. This was followed by Giovanni and colleagues,[7] who achieved extrahepatic bile duct transduodenal EUS-guided biliary drainage in a patient with pancreatic adenocarcinoma. Mallery et al[8] subsequently introduced the EUS-guided rendezvous procedure. In due course, Harada et al[9] first reported EUS-guided pancreatography in a patient following pancreaticoduodenectomy who required main pancreatic duct stone clearance. The techniques have evolved since these initial reports. The various techniques and terminologies for EUS-guided access and drainage may be summarized as follows:

1. Site of needle puncture:
   a. Intrahepatic bile duct: Hepatogastrostomy
   b. Extrahepatic bile duct: Choledochoenterostomy
   c. Main pancreatic duct: Pancreaticogastrostomy
2. Approach:
   a. Retrograde: Duodenoscope or forward-viewing endoscope used to place stent from the gut lumen through the papilla/anastomosis into the duct and is often referred to as a rendezvous procedure
   b. Antegrade: Entire procedure performed via an echoendoscope; stent placed from the gut lumen into the duct $\pm$ crossing the obstruction and papilla/anastomosis
3. Technique:
   a. Transpapillary: Stent traverses the papilla
   b. Transanastomotic: Stent traverses a surgical anastomosis
   c. Transluminal: Stent placed within duct and does not cross the papilla or anastomosis, and can be performed only via the antegrade approach

EUS-Guided Bile Duct Drainage

Transhepatic Approach

Intrahepatic bile duct access is achieved with the echoendoscope positioned within the gastric fundus or body along the lesser curve or posterior position. After identifying a desired dilated intrahepatic bile duct and excluding intervening vessels and undesired ducts, the needle is advanced into the intended duct proximal to the site of obstruction at an angle that facilitates wire passage. Under fluoroscopic guidance, contrast is injected to delineate the anatomy and guidewire is advanced through the obstruction and into the small bowel with several loops formed to minimize the risk of dislodgement. For the rendezvous approach, the echoendoscope is back-loaded, leaving the guidewire in place. A side-viewing endoscope is advanced to the papilla and the guidewire is grasped with a snare or biopsy forceps and withdrawn through the scope channel.